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Fiscal decentralization contributes to economic growth: evidence from state-level cross-section data for the United States

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Abstract

This paper provides new evidence that fiscal decentralization contributes to economic growth, in contrast to previous studies that have denied such a contribution. Our new state-level data for the United States enable us to estimate the effect of fiscal decentralization more objectively than previously, because the data set exhibits little cultural, historical, and institutional variation. We also provide the finding that the definition of fiscal decentralization is important in relation to the effect of fiscal decentralization on economic growth.

Keywords: Fiscal decentralization; Economic growth; Fiscal decentralization indicator

1. Introduction

Recently, fiscal decentralization, which involves the devolution of government fiscal responsibilities to lower levels of government, has been discussed in many

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developed countries.[1] A reason for this interest is the theoretical prediction that fiscal decentralization enhances or improves the efficiency of government and promotes economic development (see, for example, Oates [4]). In particular, the effect of fiscal decentralization on economic growth is a key issue in conventional theoretical studies and in recent empirical studies in economics.

Some papers have tried to test the effect of fiscal decentralization on economic growth. Despite widespread recognition of the contribution of fiscal decentralization to economic growth in theoretical works, none of these studies has been successful in precisely substantiating or verifying the potential contribution of fiscal decentralization to economic growth. The results obtained in these papers are briefly summarized as follows.

First, Zhang and Zou [7], using panel data for China covering the period following the reforms of the late 1970s, find that fiscal decentralization reduces provincial economic growth.

Second, Davoodi and Zou [2], using panel data for 46 developing and developed countries covering the 1970–1989 period, find a negative relationship between fiscal decentralization and economic growth for developing countries, but no relationship for developed countries.

Finally, Xie et al. [6], using time-series data for the United States covering the 1948–1994 period, show that further fiscal decentralization may be detrimental to growth.

Given that these studies fail to substantiate the theoretically predicted contribution of fiscal decentralization to economic growth, the methods used by these studies to investigate the effect of fiscal decentralization may be inappropriate. Consideration of this issue reveals problems related to the data chosen for these empirical studies.

First, Zhang and Zou [7] and Xie et al. [6] use data that cover a period of high economic growth in China and United States, respectively. In such periods, a relatively high level of government may be required to provide public investment that generates large externalities in the early stages of economic development. In this case, a negative relationship is to be expected from the data sets used by these studies.

Second, Davoodi and Zou [2] use cross-country data in which the cultural, historical, and institutional differences between countries are substantial. It may be difficult to determine the true effect of fiscal decentralization unless adjustments are made to the data to account for these differences. In fact, Davoodi and Zou [2, p. 254] recognize that the cross-country variation among developing

[1] As mentioned in Xie et al. [6], many developed countries such as the United States, the United Kingdom, and Canada are reviving debates on fiscal decentralization or devolution. In addition, fiscal decentralization has become a key issue in Japan since the law for the promotion of fiscal decentralization was enacted in 1995.

countries is one of the reasons for the negative relationship found in these countries.

Using similar techniques to those used in previous studies, we investigate the effect of fiscal decentralization by using a more appropriate data set. We use data from 50 states of the United States. We use these data for two reasons. First, this data set does not cover a period of high economic growth because the data are drawn from a recent economic survey of the United States. Second, there are no substantial historical or cultural differences across observations in this data set, since these data are cross-sectional data for a single country. Hence, these data may be useful for estimating the real effect of fiscal decentralization on economic growth. Unlike those of other studies, the estimation results of this paper show that fiscal decentralization does contribute to economic growth, which is a result that corresponds to theoretical work.

This paper is organized as follows. Section 2 illustrates four indicators of fiscal decentralization in order to respond to discussions of fiscal decentralization. The data and the estimation are discussed in Section 3. Section 4 presents the empirical results, and Section 5 concludes the paper.

2. Measures of fiscal decentralization

Although fiscal decentralization is discussed as a political issue in many countries, the term is not sufficiently clear even in the fields of political science or public administration.[2] To investigate statistically the potential contribution of fiscal decentralization to economic growth, a quantitative measure of fiscal decentralization must be constructed.

Generally, fiscal decentralization is interpreted as devolution of the authority associated with decision making to a lower-level government. To measure fiscal decentralization, we have to know the degree of devolution or the level of authority of the lower-level government. Authority associated with decision-making has been allocated on the basis of legal relationships between higher- and lower-levels government. However, it is difficult to measure quantitatively the allocation of authority.

The standard approach to measuring the allocation of authority is to make use of accounting measures such as revenue or expenditure. However, there are some reservations about using accounting information to obtain accurate measures of the allocation of authority.

First, expenditure by lower-levels government may be financed by inter-governmental grants from higher-levels government. Hence, the share of expenditure in the total budget does not necessarily reflect the level of authority allocated

[2] For example, Bird and Vaillancout [1] discuss various measures of fiscal decentralization.

to a lower-level government because, to some extent, its grant relates to expenditure authorized by a higher-level government. Therefore, it is inappropriate to regard expenditure shares as necessarily an accurate measure of shares of authority. Given the allocation of lump-sum grants, neither do revenue shares necessarily reflect shares of authority. This is because the authority associated with the spending of the lump-sum grant is attributed to the lower-level government.

Second, even if expenditure shares or revenue shares are small, authority is considered to be fiscally decentralized provided that sufficient resources for public spending are originally allocated to the lower-level government; that is, if autonomy is achieved. Therefore, autonomy should be considered as one of the indicators of fiscal decentralization.

Despite these reservations, previous studies have used an expenditure share as an indicator of fiscal decentralization. However, it is doubtful that only one indicator (for example, an expenditure share) fully captures the various dimension of fiscal decentralization. To derive a convincing general result and to respond to discussions outside the economic field (for example, political science and law), it is necessary to construct indicators of fiscal decentralization that reflect various viewpoints. Since it is difficult to develop a single measure that is completely satisfactory, we consider four decentralization indicators that measure the allocation of authority from various standpoints and, hence, deal with the two reservations mentioned above.

We deal with the first reservation by considering both the revenue and expenditure shares of governments. Simply assume that differences between revenue and expenditure correspond to inter-governmental grants. As Oates [3] suggests, when the grantor directs in some detail the purposes for which the funds are to be used, the grants should be attributed to the level of government that collects the revenues. This is because the authority relating to the use of the grant may belong to the grantor. Then the share of revenue in the total budget (indicator 1) may approximately measure the degree of authority. By contrast, lump-sum grants or grants that are unconditional should be attributed to the level of government that undertakes the expenditure. Then the share of expenditure in the total budget (indicator 2) may approximately measure the degree of authority. These two indicators are regarded as two extreme cases relating to the allocation of authority. For the case in the middle, the indicator (indicator 4) that combines these two indicators is considered.

To deal with the second reservation, we introduce a new indicator, which reflects the fiscal autonomy of local government (indicator 3). This indicator considers how public spending at lower-level government is maintained on the basis of its revenue.

Detailed explanations of these four types of indicators follow. (Statistical characteristics of the computed indicators are presented in Appendix A.)

2.1. Revenue indicator (indicator 1)

The revenue indicator (RI) is defined for each state as the ratio of local government revenue to combined state and local government revenue.[3] This indicator corresponds to the most approximate measure of the allocation of authority when the government that collects revenue has authority associated with its own revenue (the tax to be collected and the type of expenditure to be made), but all inter-governmental grants are conditional or matching grants. In calculating a revenue share, we use government revenue excluding grants from other governments.

2.2. Production indicator (indicator 2)

The production indicator (PI) is defined for each state as the ratio of local government expenditure to combined state and local government expenditure.[4] This indicator corresponds to the most approximate measure of the allocation of authority when a local government has authority associated with its expenditure (the tax to be collected and the type of expenditure to be made) implicitly considering that all inter-governmental grants are non-matching or lump-sum grants. In calculating an expenditure share, we use government expenditure including grants from other governments.

2.3. Autonomy indicator (indicator 3)

This indicator measures the autonomy (degree of fiscal independence) of a local government in a state. For instance, even if the revenue or expenditure share of local government is small in relation to total revenue or expenditures within a state, local government autonomy is high if all fiscal needs are financed in the local government region, in which authority may be fiscally decentralized. Therefore, autonomy should be considered as one of the measures of fiscal decentralization. The autonomy indicator (AI) is defined as the local government's own revenue share of its total revenue. This indicator equates to the grants share (the share of grant revenue in total revenue) subtracted from unity. In calculating the autonomy of the local government in a state, the federal grant provided from outside the state should be considered. Hence, we consider two indicators for AI to account for the potential impact of the federal grant. AI_I represents the local government's real fiscal independence and is based on the local government's own revenue and total revenue, with both revenues *excluding* federal grants.

[3] In order to grasp authority allocation accurately, we exclude revenues financed by public debt from both state and local revenue data.

[4] Similar to Davoodi and Zou [2] and Xie et al. [6], expenditure for redeeming public debt is included in both state and local expenditure data.

AI_{II} represents actual independence from the state government, and is based on the local government's own revenue and the total revenue, with both revenues *including* federal grants.

2.4. Production-revenue indicator (indicator 4)[5]

The production-revenue indicator (PRI) represents a decentralization measure that incorporates both revenue and expenditure shares. The normalized indicator is defined as the mean of indicators 1 and 2; that is, $\mathrm{PRI} = (\mathrm{PI} + \mathrm{RI})/2$.

3. Empirical analysis

3.1. Empirical model

Following Xie et al. [6], the growth regression is written as

$$\Delta \mathrm{GSP}_i = \alpha_0 + \alpha_1 \,\mathrm{Decentralization}_i + X_i\beta + \varepsilon_i, \quad i = 1, \ldots, 50, \tag{1}$$

where i refers to state i; $\Delta\,\mathrm{GSP}_i$ represents the average annual growth rate of per capita gross state product (GSP) between 1992 and 1996; $\mathrm{Decentralization}_i$ represents indicators of fiscal decentralization in state i; X_i is control variables comprising state characteristics. The parameters α_0 and α_1 are scalars, β represents a parameter vector, and ε_i is an error term, which is assumed to be normally distributed, homoscedastic, and independent across observations. Eq. (1) is estimated by the method of ordinary least squares (OLS) on cross-section state-level data.[6]

3.2. Variables

Characteristics of the data used are summarized in Table 1. First, the four indicators of fiscal decentralization described in Section 2 are introduced into the regression as alternate independent variables to test the effect of fiscal decentralization on economic growth. The economic theory developed by Oates [4] predicts that fiscal decentralization contributes to economic growth, that is, $\alpha_1 > 0$.

[5] Steunenberg and Mol [5] suggest a similar decentralization measure that incorporates revenue and expenditure shares, which is computed as $\sqrt{\mathrm{PI}^2 + \mathrm{RI}^2}/\sqrt{2}$. However, the problem with this indicator is that degrees of both fiscal decentralization and fiscal centralization may increase at the same time following reforms, since the degree of decentralization and the degree of centralization do not necessarily sum to unity, as is the case for other indicators.

[6] Panel regression with similar results is also performed. These results are reported in Appendix B.

Table 1
Variable definitions, means, and standard deviations

Variable	Mean	Standard deviation	Definition
Δ GSP	0.2771	0.0136	Average annual growth rate of real GSP per capita over the 1992–1996 period
POP	0.2603	0.0106	Average annual growth rate of state population over the 1988–1992 period
Δ GSP(-1)	0.2572	0.0146	Average annual growth rate of per capita real GSP over the 1988–1992 period
EDUC	0.0914	0.0136	Percentage of high school graduates in total population aged 18–24 years in 1992
LIB vs. CON	0.5213	0.1554	The share of seats in state legislature held by Democrats in 1992
GINI	0.0909	0.0230	Gini coefficient calculated from pre-tax income differences between counties within a state in 1992
SOUTHERN	0.32	0.4712	Dummy variable indicating state's location in the southern region; Alabama, Arkansas, Delaware, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia.
PATENTS	0.02	0.0276	The state's share of total US patents issued in 1992
OPENNESS	0.0554	0.0386	Ratio of state's exports to other countries and other states to nominal GSP in 1992
			Indicators of fiscal decentralization
RI	0.3868	0.0858	Ratio of local government revenue to state and local government revenue in 1992
PI	0.4613	0.0825	Ratio of local government expenditure to state and local government expenditure in 1992
AI_I	0.6884	0.0783	Ratio of local government's own revenue to total revenue, with revenues excluding federal grants in 1992
AI_{II}	0.6661	0.0754	Ratio of local government's own revenue to total revenue, with revenues including federal grants in 1992
PRI	0.4241	0.0813	$(PI + RI)/2$, which reflects both revenue and expenditure aspects of fiscal decentralization in 1992

USA COUNTIES 1998, Statistical Abstract of the United States1998, State and Metropolitan Area Data Book 1997–1998.

Second, we include a large number of state economic characteristics in the empirical model to capture all the relevant economic effects on growth after controlling for differences across states. Most of these explanatory variables used are similar to those used in the regression model of Xie et al. [6].[7] However, in

[7] However, due to limited data availability, we were unable to use all of the variables included by these authors.

addition to the variables used by these authors, we include several others justified by regional growth theory. A list of the variables used follows. We use explanatory variables measured at 1992 data (the initial year in our sample) to deal with potential endogeneity problems, with the exception of POP and ΔGSP(-1) (see Table 1 for definitions, means, and standard deviations).

- Population growth rate over the 1988–1992 period (POP);
- Average annual growth rate of per capita GSP over the 1988–1992 period (Δ GSP(-1));
- Education level and labor quality, measured by the level of human capital (EDUC);
- Liberal vs. Conservative tendencies, measured by the share of the seats in the state legislature held by Democrats (LIB vs. CON);
- The effect of income distribution, measured by Gini coefficients (GINI);
- Quality of regional human capital, measured by patents (PATENTS);
- Economic structure, measured by trade (OPENNESS);
- Regional-specific effect (SOUTHERN).

These variables (except for SOUTHERN) are included in the regression in the logarithmic form after transformed into natural logarithms.

Predictions can be stated for the effects of some of these variables. First, since models often suggest that population increases enhance economic growth, the effect of POP on GSP growth is expected to be positive. Second, since a higher education level may increase economic activity, the effect of EDUC on GSP growth is expected to be positive. Third, since a high level of income inequality requires income redistribution within the region and may reduce incentives to work, one would expect the effect of GINI on GSP growth to be negative. Fourth, since the quality of human capital in a state (PATENTS) develops the regional economy, the effect of PATENTS on GSP growth is expected to be positive. Although it is difficult to predict the effects of the remaining variables on GSP growth, they are included in the model to capture unexpected influences.

All data used in this paper are from the following sources: USA COUNTIES 1998; Statistical Abstract of the United States 1998; and State and Metropolitan Area Data Book 1997–1998.

4. Regression results

Results based on four different types of indicator for fiscal decentralization are presented in Table 2. (We added models that omitted OPENNESS and PATENTS to test the robustness of the regression results from the basic specification.)

Table 2
Regression results

Indep. var.	(2.1)	(2.2)	(2.3)	(2.4)	(2.5)	(2.6)	(2.7)	(2.8)	(2.9)	(2.10)
RI	0.07	0.14	–	–	–	–	–	–	–	–
	[0.90]	[1.86]*	–	–	–	–	–	–	–	–
PI	–	–	0.16	0.22	–	–	–	–	–	–
	–	–	[1.73]*	[3.00]***	–	–	–	–	–	–
AI_I	–	–	–		−0.07	−0.08	–	–	–	–
	–	–	–	–	[0.85]	[0.99]	–	–	–	–
AI_{II}	–	–	–	–	–	–	−0.06	−0.07	–	–
	–	–	–	–	–	–	[0.79]	[0.86]	–	–
PRI	–	–	–	–	–	–	–	–	0.11	0.19
	–	–	–	–	–	–	–	–	[1.29]	[2.46]**
POP	−0.87	−0.82	−0.88	−0.87	−0.89	−0.86	−0.89	−0.86	−0.87	−0.83
	[2.74]***	[2.55]**	[2.86]***	[2.89]***	[2.80]***	[2.62]**	[2.81]***	[2.62]**	[2.77]***	[2.68]***
ΔGSP(−1)	1.16	1.03	1.04	0.96	1.17	1.05	1.17	1.05	1.11	0.99
	[3.38]***	[3.03]***	[3.04]***	[2.98]***	[3.42]***	[3.02]***	[3.41]***	[3.00]***	[3.23]***	[3.00]***
EDUC	0.01	−0.02	−0.01	−0.03	−0.01	−0.06	−0.01	−0.06	0.003	−0.02
	[0.16]	[0.44]	[0.19]	[0.63]	[0.16]	[1.14]	[0.13]	[1.11]	[0.04]	[0.47]
LIB vs. CON	−0.08	−0.08	−0.07	−0.07	−0.10	−0.13	−0.10	−0.13	−0.07	−0.07
	[1.02]	[1.15]	[1.00]	[1.03]	[1.43]	[1.89]*	[1.43]	[1.89]*	[0.98]	[1.05]
GINI	−0.08	−0.07	−0.08	−0.07	−0.08	−0.07	−0.08	−0.07	−0.08	−0.07
	[3.48]***	[3.05]***	[3.50]***	[3.42]***	[3.68]***	[3.06]***	[3.67]***	[3.04]***	[3.47]***	[3.22]***
PATENTS	0.01	–	0.007	–	0.01	–	0.01	–	0.009	–
	[1.88]*	–	[1.04]	–	[2.44]**	–	[2.46]**	–	[1.49]	–
OPENNESS	−0.003	–	−0.003	–	−0.004	–	−0.004	–	−0.003	–
	[0.25]	–	[0.32]	–	[0.43]	–	[0.40]	–	[0.27]	–
SOUTHERN	0.01	0.01	0.01	0.01	0.02	0.01	0.02	0.01	0.01	0.01
	[0.91]	[0.70]	[0.84]	[0.69]	[1.06]	[0.85]	[1.07]	[0.89]	[0.86]	[0.66]
Constant	−1.09	−1.30	−1.36	−1.54	−1.08	−1.33	−1.07	−1.34	−1.19	−1.40
	[3.58]***	[4.66]***	[3.96]***	[5.63]***	[3.57]***	[4.65]***	[3.55]***	[4.64]***	[3.76]***	[5.12]***
Adjusted R^2	0.37	0.34	0.40	0.41	0.37	0.31	0.37	0.30	0.38	0.38

Dep. var: average annual growth (1992–1996). Figures in parentheses are the absolute values of t-statistics. Asterisks indicate variables whose coefficients are significant at the 10(*), 5(**), and 1%(***) levels. The total number of observations are 50.

The empirical findings can be stated as follows. The primary finding is that the estimated coefficient on fiscal decentralization (α_1 in (1)), is positive and statistically significant at the 1, 5, and 10% levels in regressions that include indicator 1 (RI), indicator 2 (PI), or indicator 4 (PRI) (see columns (2.2)–(2.4) and (2.10) in Table 2). This finding provides evidence that fiscal decentralization contributes to economic growth. It is important to note that this finding is not consistent with the results of previous papers, but is consistent with the theoretical predictions of Oates [4].[8] Moreover, it should be emphasized that indicator 2 (PI), which is similar to those of previous studies, is positively signed and statistically significant at the 1% level in a regression with a limited set of variables.

These new findings are due to the use of a new, more appropriate, data set. These data have several desirable features. First, the data used here exhibit little historical or cultural variation, unlike the cross-country data set used by Davoodi and Zou [2], in which such variations between observations are substantial. Second, the period covered by the data does not include an economic development stage because the data are recent United States data. By contrast, the time series and panel data used by Zhang and Zou [7] and Xie et al. [6] cover periods that include economic development stages in the countries under study. Thus, the results obtained here may describe the likely effects of future fiscal decentralization in developed countries.

Insignificant effects of AI_I and AI_{II} are found in regressions that include fiscal decentralization indicator 3 (see columns (2.5)–(2.8) in Table 2). This means that it is difficult to determine the effect of fiscal decentralization on economic growth when autonomy is used as an indicator of fiscal decentralization. It should be apparent from this result that the definition of fiscal decentralization is an important issue in the context of the effect of fiscal decentralization on economic growth.

Concerning the estimated coefficients of other state characteristics, some conclusions emerge from the results in Table 2. While some variables significantly affect economic growth, others for which an effect was expected have insignificant coefficients. Detailed discussion follows.

First, we have controlled for the quality of regional human capital by using two variables (PATENTS and EDUC). PATENTS has the expected positive effect, which is statistically significant in regressions that include indicator 1 (RI) and

[8] As a referee has pointed out, it is important to explain intuitively why Davoodi and Zou [2] find no evidence of such a relationship from a similar cross-section regression for a similar group of developed countries. The explanation concerns country-specific effects. It may be difficult to adjust adequately enough for country-specific effects where there are historical and cultural differences. Analysis will fail to reveal the true effect of fiscal decentralization on economic growth if adjustment for country-specific effects is inadequate. Our data set has the advantage that variations between observations are relatively small, which facilitates adjustment for region-specific effects.

indicator 3 (AI) (see columns (2.5) and (2.7) in Table 2), while the effect of EDUC is not significant in all regression models. This result means that PATENTS represents a real benefit of accumulated human intelligence, while EDUC (which indicates education levels) may serve as a poor proxy for the effect of the quality of regional human capital, perhaps because of migration to other regions.

Second, the estimated coefficient of $\Delta\,\mathrm{GSP}(-1)$ is positive and significant at the 1% level in all regression models. This means that economic growth in the previous period is an important determinant of economic growth in the current period.

Third, the estimated coefficient of GINI is negative, as expected, and significant at the 1% level in all regression models. This result suggests that income inequality reduces economic growth and confirms the findings of Xie et al. [6]. It may be that incentives to work are lower in regions needing a redistribution policy to reduce income inequality.

Fourth, the estimated coefficient of LIB vs. CON is negative and significant at the 10% level in some regressions (see columns (2.6) and (2.8) in Table 2).

Finally, insignificant coefficients were observed for SOUTHERN and OPENNESS, both of which were expected to have an effect. An explanation for the insignificance of the SOUTHERN dummy is that it is difficult to determine the region-specific effect in a cross-section regression by using only a regional dummy. Panel data, which have both a cross-section and a time-series dimension, are useful for controlling for the regional-specific effect (see Appendix B for a trial panel regression.) Since OPENNESS is based on all types of trade, it may represent an imperfect measure of regional economic structure.

The empirical findings can be summarized as follows. Most importantly, the results provide convincing evidence that fiscal decentralization contributes to economic growth. Unlike previous papers, this paper finds that fiscal decentralization does indeed play an important role in economic growth. As expected, the results also indicate that several other factors affect economic growth. To see why our results on the effect of decentralization differ from those of other studies, suppose that the effect of fiscal decentralization changes according to history, culture, and stage of economic development. To determine the true effect of fiscal decentralization in the developed countries, it is necessary to use data for those countries from which historical differences are absent. The data used in this paper satisfy this requirement.

5. Conclusion

The effect of fiscal decentralization on economic growth has been a major focus of debate and discussion in the context of recent public reforms. This paper has presented new empirical evidence on this important issue. Having

provided evidence that fiscal decentralization contributes to economic growth, this paper suggests that recent moves toward fiscal decentralization by developed countries may stimulate their economic growth. This finding is consistent with existing theoretical results, but contradicts the empirical results of previous studies.

The nature of the data set used in the regression analysis of this paper explains why our results substantiate existing theoretical results and why those of other studies do not. As already mentioned, our data set is one in which differences relating to history, culture, and the stage of economic development are minimal, and hence admirably suited to determining the true effect of fiscal decentralization on economic growth. This distortion-free data set has revealed the true positive effect of fiscal decentralization.

To investigate the contribution of fiscal decentralization more thoroughly, it is necessary to construct accurate decentralization indicators that reflect the political and institutional processes that assign the authority to raise taxes and undertake public spending.

Finally, it is important to note that, although the results of this paper provide evidence of a contribution to economic growth, they do not demonstrate how fiscal decentralization contributes to economic growth. Further research based on theoretical models is required to explain the mechanisms involved.

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Appendix A. Data characteristics

Table A.1
Correlation coefficients between fiscal decentralization indicators correlation matrix

1992	RI	PI	AI_I	AI_{II}	PRI
RI	1.000				
PI	0.865	1.000			
AI_I	0.506	0.173	1.000		
AI_{II}	0.560	0.222	0.993	1.000	
PRI	0.967	0.964	0.355	0.408	1.000

This table shows correlations between five decentralization indicators. It is apparent that RI, PI, and PRI are highly correlated with each other. However, AI_I and AI_{II} are less correlated with other indicators.

Table A.2
Degree of fiscal decentralization by state and indicator (1992)

1992	RI	PI	AI_I	AI_{II}	PRI
Alabama	0.396	0.466	0.707	0.686	0.431
Alaska	0.214	0.323	0.654	0.630	0.269
Arizona	0.468	0.561	0.686	0.665	0.515
Arkansas	0.316	0.389	0.590	0.575	0.353
California	0.439	0.543	0.606	0.591	0.491
Colorado	0.485	0.584	0.751	0.731	0.534
Connecticut	0.358	0.407	0.724	0.705	0.382
Delaware	0.216	0.329	0.581	0.561	0.272
Florida	0.529	0.587	0.742	0.723	0.558
Georgia	0.513	0.557	0.754	0.730	0.535
Hawaii	0.203	0.221	0.892	0.831	0.212
Idaho	0.310	0.441	0.594	0.577	0.376
Illinois	0.464	0.515	0.736	0.704	0.489
Indiana	0.398	0.507	0.657	0.643	0.453
Iowa	0.404	0.492	0.677	0.660	0.448
Kansas	0.480	0.551	0.756	0.745	0.516
Kentucky	0.299	0.377	0.604	0.584	0.338
Louisiana	0.411	0.430	0.693	0.665	0.421
Maine	0.315	0.378	0.673	0.651	0.347
Maryland	0.403	0.455	0.749	0.720	0.429
Massachusetts	0.373	0.432	0.705	0.674	0.402
Michigan	0.439	0.551	0.709	0.693	0.495
Minnesota	0.406	0.532	0.634	0.614	0.469
Mississippi	0.397	0.474	0.620	0.597	0.436
Missouri	0.427	0.494	0.717	0.697	0.460
Montana	0.286	0.401	0.643	0.595	0.344
Nebraska	0.583	0.595	0.825	0.806	0.589
Nevada	0.371	0.516	0.616	0.582	0.443
New Hampshire	0.467	0.427	0.875	0.854	0.447
New Jersey	0.364	0.424	0.647	0.639	0.394
New Mexico	0.247	0.399	0.498	0.478	0.323
New York	0.509	0.527	0.700	0.684	0.518
North Carolina	0.398	0.514	0.649	0.630	0.456
North Dakota	0.317	0.360	0.632	0.606	0.338
Ohio	0.340	0.457	0.682	0.658	0.399
Oklahoma	0.348	0.427	0.649	0.631	0.388
Oregon	0.384	0.529	0.746	0.705	0.456
Pennsylvania	0.374	0.447	0.682	0.654	0.411
Rhode Island	0.308	0.301	0.746	0.715	0.304
South Carolina	0.358	0.425	0.687	0.666	0.391
South Dakota	0.413	0.451	0.783	0.745	0.432
Tennessee	0.537	0.560	0.812	0.791	0.549
Texas	0.515	0.558	0.754	0.738	0.537
Utah	0.421	0.493	0.715	0.700	0.457
Vermont	0.348	0.366	0.730	0.720	0.357
Virginia	0.422	0.503	0.720	0.699	0.462
Washington	0.383	0.475	0.668	0.649	0.429

Table A.2 (*continued*)

1992	RI	PI	AI_I	AI_{II}	PRI
West Virginia	0.268	0.346	0.547	0.534	0.307
Wisconsin	0.328	0.519	0.590	0.576	0.423
Wyoming	0.388	0.449	0.611	0.598	0.419

Appendix B. Panel data analysis

B.1. Panel regression model

The use of data with time-series and cross-section dimensions enables consideration of state-specific characteristics. Therefore, we estimate the panel regression model below in order to test the robustness of the clear-cut results obtained from our simple cross-section regression analysis of Section 4.

Our panel data cover the periods 1992–1994 and 1994–1996 in the United States. Eq. (B.1) is the panel regression model to be estimated by OLS. We consider the one-way fixed-effects model.[9]

$$\Delta \mathrm{GSP}_{it} = \alpha_0 + \alpha_1 \mathrm{Decentralization}_{it} + X_{it}\beta + \delta_1 S_i + \varepsilon_{it},$$
$$i = 1, \ldots, 50,\ t = 1, 2, \tag{B.1}$$

where i and t refer to country i and time t, respectively; X_{it} is state characteristics; S_i is a vector of $I - 1$ $(= 49)$ state fixed effects (i.e., state dummies); and Δ GSP represents average annual growth over the two-year period from 1992 and 1994. Therefore, there are 100 observations for the panel regression. All other explanatory variables used here are measured as of the initial year in each cross-section sample; that is, 1992 and 1994.

B.2. Results from panel regression

The results of estimating (B.1) are presented in Table B.1. (With the exception of the decentralization indicators, all variables were transformed into natural logarithms.) Focusing on the effect of decentralization, it is found that even after using panel data analysis to account for state-specific effects, the main result concerning the effect of fiscal decentralization survives; that is, the main results obtained from the panel regression are similar to those obtained in Section 4. Focusing on the regression that includes the most important coefficient, that for indicator 2 (PI) and 4 (PRI), Table B.1 shows that the estimated coefficient on fiscal decentralization (α_1 in (B.1)), is positive and statistically significant at the

[9] F-tests and Hausman tests reject two-way and random-effects specifications in all regressions.

Table B.1
Panel regression results

Indep. var.	(3.1)	(3.2)	(3.3)	(3.4)	(3.5)	(3.6)	(3.7)	(3.8)	(3.9)	(3.10)
RI	0.33	0.33	–	–	–	–	–	–	–	–
	[1..05]	[1.08]	–	–	–	–	–	–	–	–
PI	–	–	0.32	0.32	–	–	–	–	–	–
	–	–	[2.29]**	[2.32]**	–	–	–	–	–	–
AI_I	–	–	–	–	−0.16	−0.15	–	–	–	–
	–	–	–	–	[0.60]	[0.59]	–	–	–	–
AI_{II}	–	–	–	–	–	–	−0.33	−0.31	–	–
	–	–	–	–	–	–	[1.17]	[1.15]	–	–
PRI	–	–	–	–	–	–	–	–	0.48	0.47
	–	–	–	–	–	–	–	–	[2.27]**	[2.31]**
POP	−0.02	−0.02	−0.01	−0.01	−0.17	−0.17	−0.22	−0.21	0.04	0.04
	[0.06]	[0.06]	[0.03]	[0.04]	[0.54]	[0.55]	[0.68]	[0.68]	[0.14]	[0.15]
Δ GSP(−1)	−0.32	−0.32	−0.27	−0.27	−0.30	−0.30	−0.28	−0.29	−0.28	−0.29
	[3.72]***	[4.28]***	[3.22]***	[3.73]***	[3.34]***	[3.88]***	[3.24]***	[3.82]***	[3.45]***	[4.00]***
EDUC	0.11	0.11	0.12	0.12	0.09	0.09	0.09	0.09	0.12	0.12
	[1.10]	[1.11]	[1.28]	[1.28]	[0.96]	[0.96]	[0.90]	[0.90]	[1.27]	[1.28]
LIB vs. CON	0.16	0.15	0.01	0.002	0.13	0.13	0.13	0.12	0.05	0.05
	[1.96]*	[2.00]**	[0.06]	[0.02]	[1.69]*	[1.72]*	[1.65]	[1.68]*	[0.64]	[0.62]
GINI	0.18	0.18	0.20	0.19	0.17	0.17	0.18	0.18	0.20	0.20
	[1.50]	[1.63]	[1.70]*	[1.85]*	[1.41]	[1.53]	[1.49]	[1.63]	[1.71]*	[1.87]*
PATENTS	0.01	–	0.02	–	0.02	–	0.02	–	0.02	–
	[0.31]	–	[0.42]	–	[0.38]	–	[0.45]	–	[0.39]	–
OPENNESS	0.0002	–	−0.0004	–	−0.001	–	−0.004	–	−0.001	–
	[0.005]	–	[0.009]	–	[0.02]	–	[0.08]	–	[0.02]	–
Adjusted R^2	0.41	0.44	0.46	0.49	0.40	0.43	0.42	0.44	0.46	0.49
Hansman tests	63.45	61.86	54.23	54.22	64.47	63.81	66.40	65.65	61.51	60.38
P-value of Hansman tests	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Dep. var: average annual growth (92–94 and 94–96). Figures in parentheses are the absolute values of t-statistics. Asterisks indicate variables whose coefficients are significant at the 10(*), 5(**), and 1%(***) levels. Number of observations are 100. Due to limits on space, we do not report the results for the estimates of the individual dummy variables in the table. The Hausman test tests the null hypothesis of a random effects model against a fixed effects model.

5% level. (See columns (3.3), (3.4), (3.9), and (3.10) in Table B.1.) This finding confirms the robustness of the evidence that fiscal decentralization contributes to economic growth.

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